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ABSTRACT

The first part of the Self-Paced Physics Course remediation materials is presented for U. S. Naval Academy students who miss core problems on the progress check. The total of 78 problems is incorporated in this volume to match study segments 1 through 14. Each remedial sheet is composed of a statement of the missed problem and references to pertinent auxiliary material. The content is given under the headings: Measurement and Vectors, Vector Multiplication and Velocity, Motion in One and Two Dimensions, Newton's Laws of Motion, Linear Motion; Friction, Uniform Circular Motion, Work and Energy, Conservation of Energy, Motion of the Center of Mass, Linear Momentum, Impulse and Collisions in One Dimension, Collisions in Two Dimensions, Gravitation, and Gravitational Potential Energy. (Related documents are SE 016 065 - SE 016 088 and ED 062 123 - ED 062 125.) (CC)

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Course Materials - Fall, 1970

REMEDIAL SHEETS FOR PROGRESS CHECKS
Segments 1 thru 14

LIST OF TITLES

SEGMENTS AND CORE PROBLEMS

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SEGMENTS AND CORE PROBLEMS

SEGMENT 13: GRAVITATION

Problem 1: Gravitational Force Between Point Masses

4: Acceleration Due to Gravity

10: Inertial and Gravitational Mass

11: Weight on a Rotating Planet

15: Gravitational Field Strenghth

19: Gravitational Effects of Spherically Symmetric Mass Distribution

SEGMENT 14: GRAVITATIONAL POTENTIAL ENERGY

Problem 1: Gravitational Potential Energy

6: Gravitational Potential

10: Conservation of Energy in the Gravitational Field

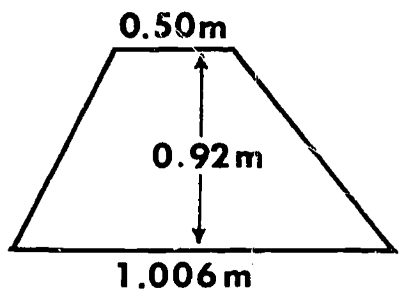
14: Escape Velocity

SEGMENT 1

MEASUREMENT AND VECTORS

Problem 1: Significant Digits

1.



The dimensions of the trapezoid shown in the figure were measured with different instruments. The area of the trapezoid should be written as:

A. $0.69276\ m^2$
B. $0.69\ m^2$
C. $0.6946\ m^2$
D. $0.7\ m^2$

Reading Assignment:

Review the Information Panel on significant digits in the P. & S. for Segment 1.

SEGMENT 1

MEASUREMENT AND VECTORS

Problem 6: Addition of Vectors

6. A plane travels 40 miles due north, then changes its course to a direction of 37°east of north and travels for 50 miles. Finally it travels for 30 miles due east. Its total displacement is:

A. 100 miles
B. 120 miles
C. 100 miles at 37° east of north
D. 120 miles at 37° east of north

Reading Assignment:

Halliday and Resnick:	Ch. 2, Sect. 1-3
Semat and Blumenthal:	Vol. I, Ch. 2, Fr 11-18, 36-40

Related Problems:

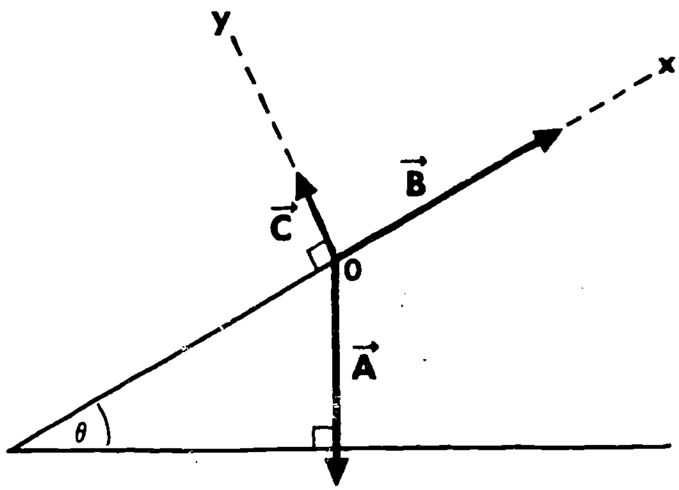
Schaum:	Ch. 1, Nos. 1, 2, 14

SEGMENT 1

MEASUREMENT AND VECTORS

Problem 10: Resolution of Vectors

10.



Find the components R_x and R_y of the vector $\vec{R}$, where vector $\vec{R}$ is the resultant (sum) of the vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$. Use the coordinate system indicated.

A. $R_x = A \sin\theta$ $R_y = A \cos\theta$

B. $R_x = B \cos\theta$ $R_y = A \sin\theta$

C. $R_x = B - A \sin\theta$ $R_y = C - A \cos\theta$

D. $R_x = C - B \cos\theta$ $R_y = A - B \sin\theta$

Reading Assignment:

Halliday and Resnick: Ch. 2, Sect. 3

Semat and Blumenthal: Vol. I, Ch. 2, Pr 34-36

Related Problems:

Schaum: Ch. 1, Nos. 10, 11, 14

SEGMENT 1

MEASUREMENT AND VECTORS

Problem 13: Dimensional Checking

13. A car moving at a constant rate R covers a distance D during a time interval T. Its rate can be expressed in

   A. Ft-min
   B. sec per ft
   C. yd per hr
   D. mi-hr.

Reading Assignment:

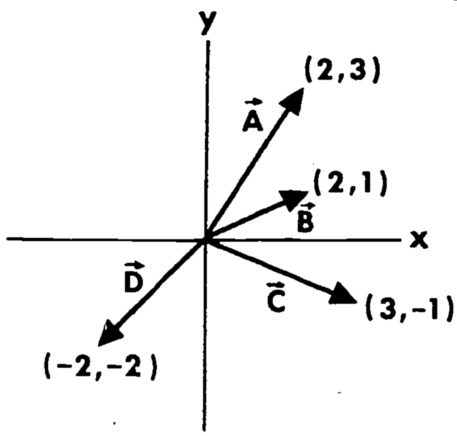
Halliday and Resnick: Ch. 3, Sect. 9

SEGMENT 2

VECTOR MULTIPLICATION AND VELOCITY

Problem 1: Dot (Scalar) Product

1.



Four vectors $\vec{A}$, $\vec{B}$, $\vec{C}$ and $\vec{D}$ are shown in the figure. The dot product $(\vec{A} + \vec{B}) \cdot (\vec{C} - \vec{D})$ is equal to:

A. 16
B. 24
C. -8
D. -24

Reading Assignment:

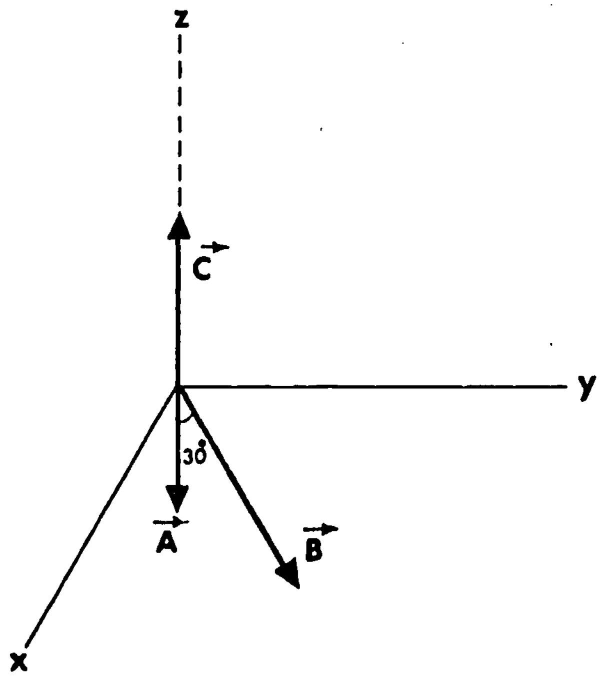
Halliday and Resnick: Ch. 2, Sect. 4

SEGMENT 2

VECTOR MULTIPLICATION AND VELOCITY

Problem 6: Cross (Vector) Product

6.



Two vectors $\vec{A}$ and $\vec{B}$ are in the xy-plane. The magnitude of $\vec{A}$ is one unit and that of $\vec{B}$ is two units. $\vec{C}$ is another vector which is along the positive z-axis. Find the product $(\vec{A}\times\vec{B})\cdot\vec{C}$.

Reading Assignment:

Halliday and Resnick: Ch. 2, Sect. 4

Problem 10: Average Speed and Average Velocity

10. A student drives due east at 80 mi/hr for one hour, then drives at 60 mi/hr for another hour due north, and then returns to the starting point with a speed of 50 mi/hr. His average velocity ($\vec{v}$) and average speed (v) over the entire journey are:

A. 0, 60 mi/hr
B. 0, 0
C. 30 mi/hr, 30 mi/hr
D. 60 mi/hr, 0

Reading Assignment:

Halliday and Resnick: Ch. 3, Sect. 3, 4

Semat and Blumenthal: Vol I, Ch. 3, Fr 2-6, 17

Joseph and Leahy: Part I, Ch. 2, Sect. 5, Fr 14-46

SEGMENT 2

VECTOR MULTIPLICATION AND VELOCITY

Problem 14: Instantaneous Velocity

14. A particle moves in one dimension. Its position is described by the equation

$$x = \alpha(2t-t^2) + \beta t^3$$

where α and β are constants. Given that the particle's position changes from $x = 3$ m at $t = 1$ sec to $x = 16$ m at $t = 2$ sec, the magnitude of the particle's velocity in m/sec at $t = 3$ sec is:

Reading Assignment:

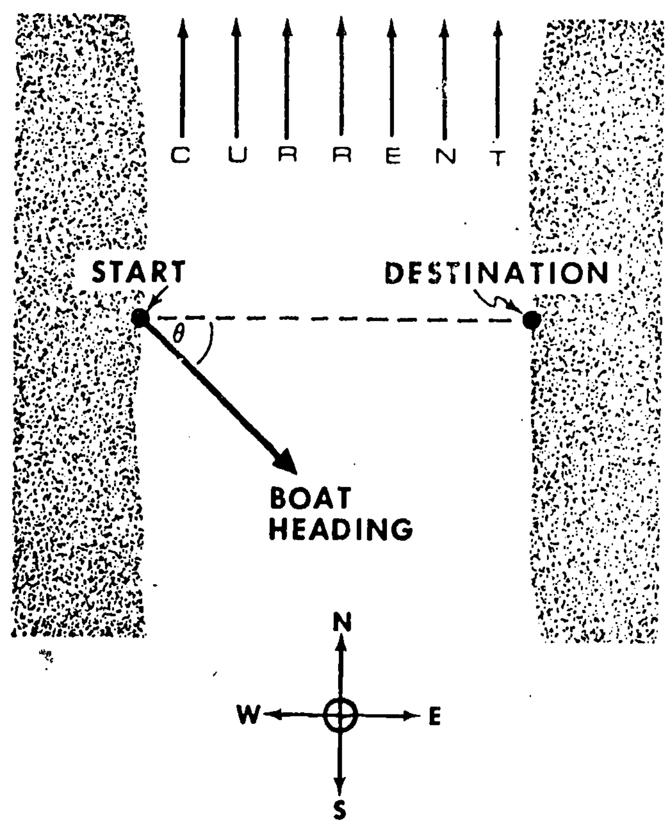
Halliday and Resnick:	Ch. 3, Sect. 4, 5
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 16-17
Joseph and Leahy:	Part I, Ch. 2, Sec. 5, Fr 14-55

SEGMENT 2

VECTOR MULTIPLICATION AND VELOCITY

Item 17: Relative Velocity

17. A boat travels at the speed of 8 mi/hr relative to the water on a 1.5 mile wide river which flows due north at 10 mi/hr. A man starting from a point on the west bank wishes to reach the east bank at a point directly opposite to his point of start. Since the boat can not travel as fast as the stream, it is incapable of landing at the destination point; consequently the man must land downstream and run back. He runs at the rate of 6 mi/hr. Find the angle θ at which the man must head his boat to reach his destination in minimum time.



Reading Assignment:

Halliday and Resnick: Ch. 3, Sect. 4; Ch. 4, Sect. 6

Semat and Blumenthal: Vol. I, Ch. 3, Fr 7-15

SEGMENT 3

MOTION IN ONE AND TWO DIMENSIONS

Problem 1: Motion in a Vertical Direction

1. A rocket ascends with an effective, resultant constant acceleration of 64 ft/sec^2. Five seconds after lift-off, however, its engine shuts off. What is the highest altitude it reaches?

Reading Assignment:

Halliday and Resnick:	Ch. 3, Sect. 8, 10, 11
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 29-36
Joseph and Leahy:	Part I, Ch. 2, Sect. 8, Fr 1-8, 25-34

Related Problems:

Schaum:	Ch. 4, Nos. 7, 8, 11, 12

SEGMENT 3

MOTION IN ONE AND TWO DIMENSIONS

Problem 6: Motion in a Vertical Direction

6. A batted baseball leaves the bat in a vertical upward direction. At the time of contact the bat was 5.0 ft above the ground. Four (4.0) seconds later the ball lands on the plate. What is the highest point above the ground that the ball reached?

Reading Assignment:

Halliday and Resnick:	Ch. 3, Sect. 8, 10, 11
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 29-36
Joseph and Leahy:	Part I, Ch. 2, Sect. 8, Fr 1-8, 25-34

Related Problems:

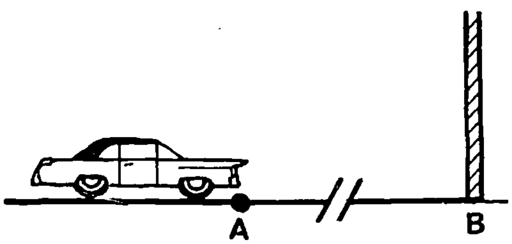
Schaum:	Ch. 4, Nos. 11, 12

SEGMENT 3

MOTION IN ONE AND TWO DIMENSIONS

Problem 9: Motion in a Horizontal Direction

9.



The distance between point A and wall B is 3000 ft. A car can develop a maximum acceleration of 15 ft/sec^2. The maximum deceleration that the brakes can provide is 30 ft/sec^2. The driver of the car wants to reach the wall B in the shortest possible time, starting from rest at point A. He uses the full accelerating capacity of the car. What is the shortest distance from B at which he must apply the brakes if he is to avoid crashing into the wall?

Reading Assignment:

Halliday and Resnick:	Ch. 3, Sect. 8
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 26-28
Joseph and Leahy:	Part I, Ch. 2, Sect. 8, Fr 9-24, 39-45

Related Problems:

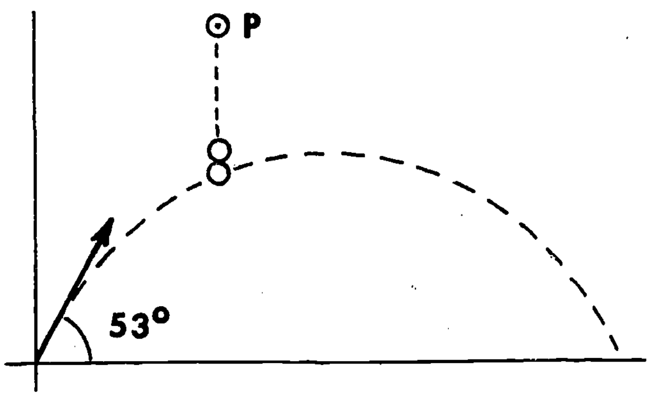
Schaum:	Ch. 4, Nos. 1, 2, 5, 6

SEGMENT 3

MOTION IN ONE AND TWO DIMENSIONS

Problem 12: Projectile Motion

12. A ball is shot from the origin with an initial velocity of 17.5 m/sec at 53° above the horizontal. At the same instant, a second ball is released from a point P shown in the figure. In one second (1 sec), the two balls collide in mid-air. What is the altitude of the point P? (HINT: Consider the two balls as point particles.)



A. 5.6 m
B. 20 m
C. 14 m
D. 10 m

Reading Assignment:

Halliday and Resnick:	Ch. 4, Sect. 1-3
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 37-50
Joseph and Leahy:	Part I, Ch. 4, Sect. 5, Fr 1-21; Sect. 6, Fr 5-11

Related Problems:

Schaum:	Ch. 4, Nos. 17, 18

SEGMENT 3

MOTION IN ONE AND TWO DIMENSIONS

Problem 18: Projectile Motion

18. A cannon can project a shell with initial speed of 500 ft/sec. Assume that the shell leaves the cannon at ground level, and that air resistance may be neglected. Find the maximum range of the cannon in miles.

Reading Assignment:

Halliday and Resnick:	Ch. 4, Sect. 1-3
Semat and Blumenthal:	Vol. I, Ch. 3, Fr 51
Joseph and Leahy:	Part I, Ch. 4, Sect. 5 Fr 1-21; Sect. 6, Fr 5-11

Related Problems:

Schaum:	Ch. 4, Nos. 18, 19

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 1: Newton's First Law

1. A body must be in translational equilibrium if

   A. it is acted upon by a constant force
   B. it has a constant velocity
   C. it has a constant acceleration
   D. no friction forces are involved

Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 1, 2
Semat and Blumenthal:	Vol I, Ch 2, Fr 19-22
Joseph and Leahy:	Part I, Ch 3, Sect 8, Fr 27-36, 40-44

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 2: Newton's First Law

2. A Particle is set in motion along a frictionless horizontal surface at a speed of one foot per second. What is its speed after ten seconds?

Reading Assignment:

Halliday and Resnick: Ch 5, Sect 1, 2

Semat and Blumenthal: Vol I, Ch 4, Pr 1-6

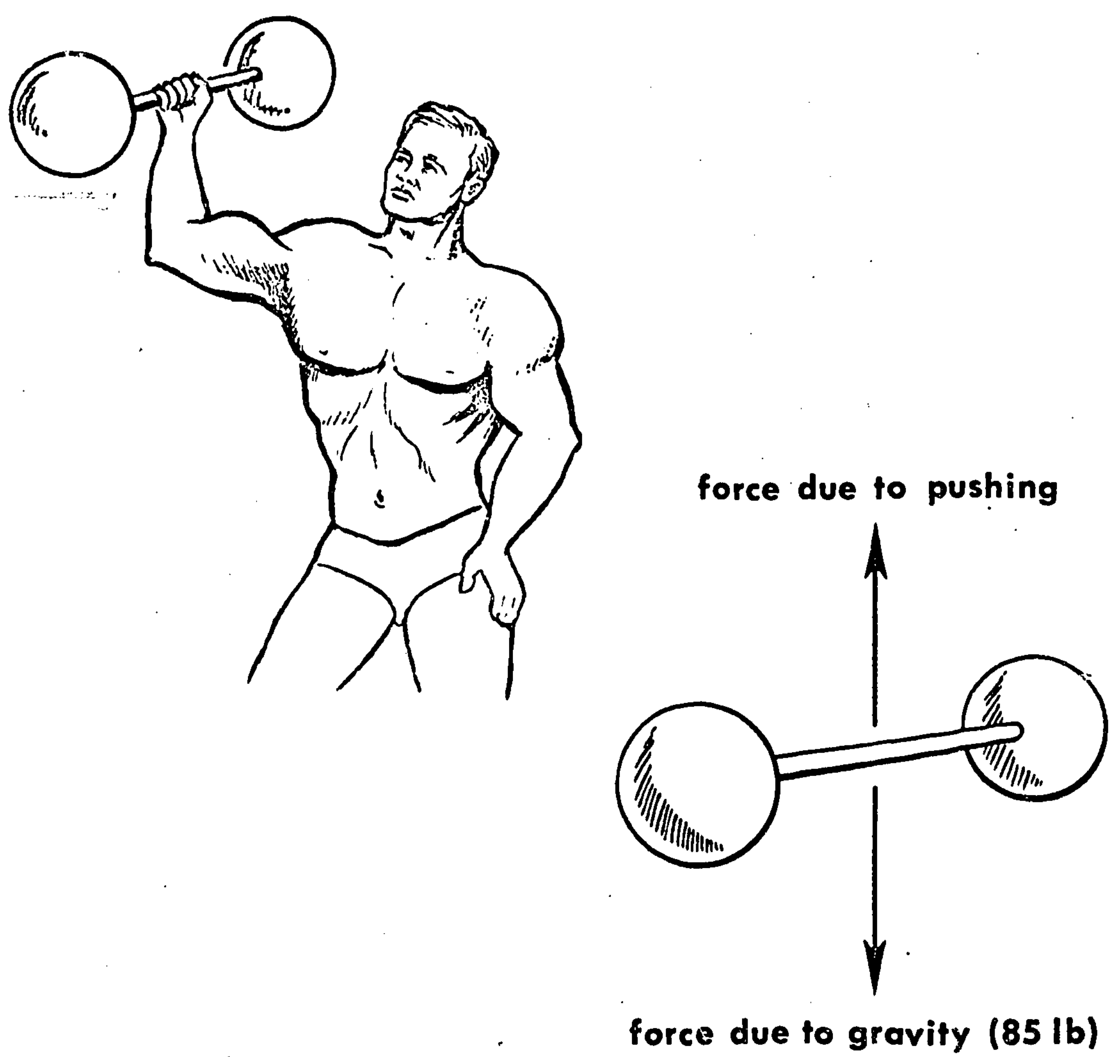
NEWTON'S LAWS OF MOTION

Problem 5: Newton's Second Law

5. Please study the figure below.

A weightlifter pushes an 85-lb dumbbell vertically upward at a constant speed of 1 ft/sec. The magnitude of the force he applies to the dumbbell

A. is greater than 85 lb
B. is equal to 85 lb
C. is less as the dumbbell rises
D. is more as the dumbbell rises



Reading Assignment:

Halliday and Resnick: Ch 5, Sect 3, 4

Semat and Blumenthal: Vol I, Ch 4, Fr 3-7, 17, 18

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 6: Acceleration Components in Projectile Motion

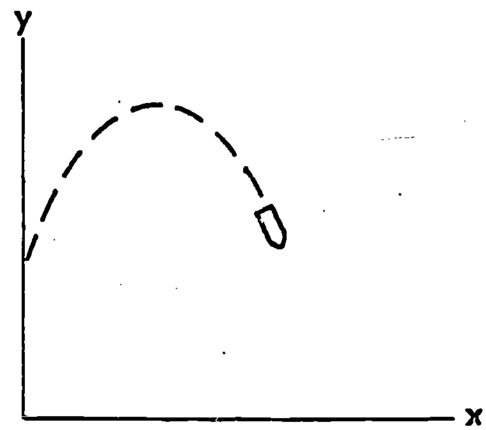
6. A projectile moves in an x-y plane (horizontal-vertical). The only force on the projectile is the force due to gravity, a force with magnitude w acting vertically downward. The mass of the projectile is m. Which of the following sets of equations (based upon Newton's second law) is correct?

A. $a_x = 0$; $a_y = -w/m$

B. $a_x = -w/m$; $a_y = w/m$

C. $a_x = w/m$; $a_y = -w/m$

D. $a_x = w/m$; $a_y = 0$



Reading Assignment:

Halliday and Resnick:	Ch 4, Sect 2, 3; Ch 5, Sect 8
Semat and Blumenthal:	Vol I, Ch 3, Fr 29,37,38; Ch 4, Fr 13,1

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 11: Mass and Weight

> 11. Near the surface of the moon, objects fall with an acceleration of 1.6 m/sec^2. What is the weight of a 3000 gram mass at the moon's surface?

Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 8
Semat and Blumenthal:	Vol I, Ch 4, Fr 13, 14
Joseph and Leahy:	Part I, Ch 4, Sect 3, Fr 1-17

Related Problems:

Schaum:	Ch 5, Nos 1, 2

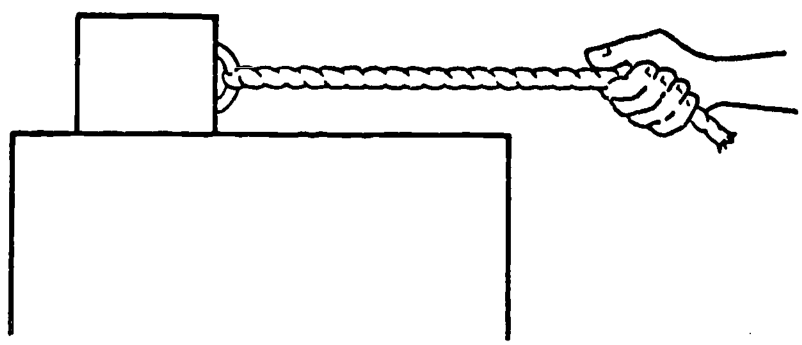
SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 16: Newton's Third Law

16. In the figure below, the reaction force to the force exerted by the hand pulling on the rope is

A. the force of the rope on the block
B. the force of the block on the rope
C. the force exerted by the block on the hand
D. the force exerted by the rope on the hand



Reading Assignment:

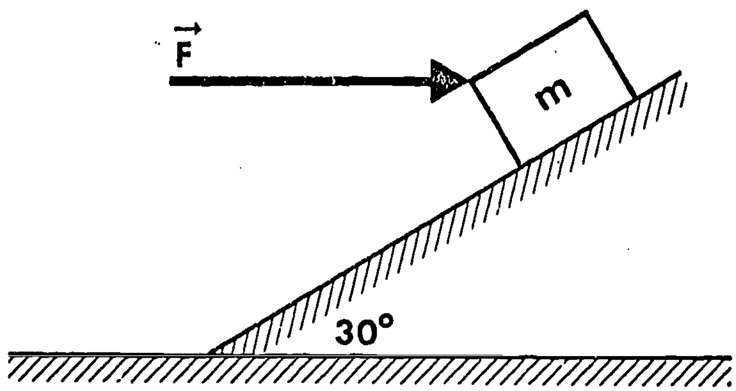
Halliday and Resnick:	Ch 5, Sect 5
Semat and Blumenthal:	Vol I, Ch 4, Fr 35, 36
Joseph and Leahy:	--------

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 21: Resolving and Equating Forces

21. A force $\vec{F}$, as shown below, of 10 nt pushes a 3-kg block along a plane inclined at 30°. If $\vec{F}$ is parallel to the horizontal surface, calculate the value of the normal force on the block.



Reading Assignment:

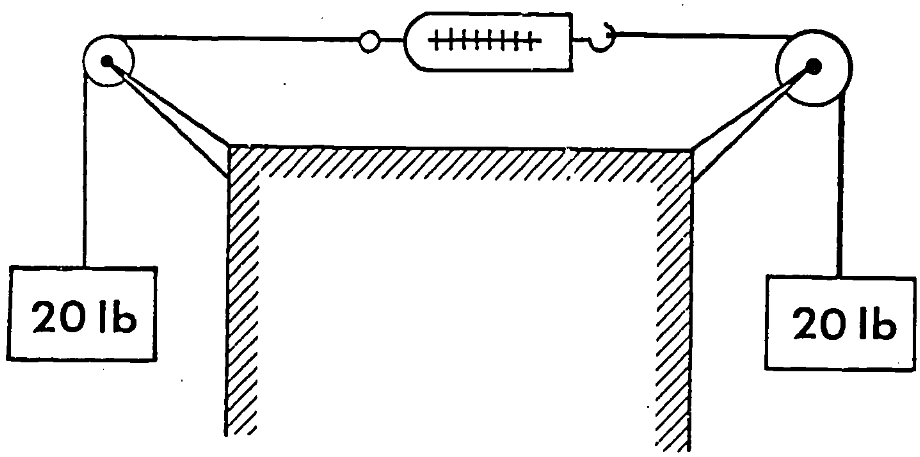
Halliday and Resnick	Ch 2, Sect 3, Ch 5, Sect 10
Semat and Blumenthal:	Vol I, Ch 2, Fr 31-35
Joseph and Leahy:	Part I, Ch 3, Sect 6, Fr 1-30

SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 26: Forces in Equilibrium

26. Below, two stationary 20-lb blocks are shown attached to a spring balance. The string connecting each block to the balance is massless and the pulleys (different radii) are also massless and frictionless. What is the reading on the spring balance?



Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 9, 10
Semat and Blumenthal:	Vol I, Ch 2, Pr 9; Ch 4, Pr 7, 17

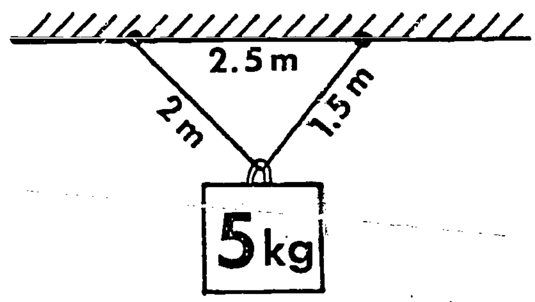
SEGMENT 4

NEWTON'S LAWS OF MOTION

Problem 29: Forces in Equilibrium

29. A mass [illegible] kg is suspended from the ceiling by two cords, one of length [illegible] and the other of length 2 m. The distance between the points [illegible] port on the ceiling is 2.5 m. What is the tension in the 2-m c[illegible] (Note: dimensions shown form 3-4-5 triangle.)

A. 3 k[illegible]
B. 4 n[illegible]
C. 39[illegible]
D. 29[illegible]



Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 10, Ex 3
Semat and Blumenthal:	Vol I, Ch 2, Fr 38-40

Related Problems:

Schaum:	Ch 3, Nos 1, 5

SEGMENT 4

NEWTON'S LAWS OF MOTI

Problem 32: Newton's Second Law

32. A sled of mass m slides down an icy slope that makes an angle θ with the horizontal. Assuming perfectly frictionless conditions, derive general equations for:

(a) the acceleration a of the sled
(b) the resultant (or total) force R acting on the sled
(c) the reaction force N acting on the sled

Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 4, 8, 10
Semat and Blumenthal:	Vol I, Ch 4, Fr 23, 24
Joseph and Leahy:	Part I, Ch 3, Sect 10, Fr 20-23

Related Problems:

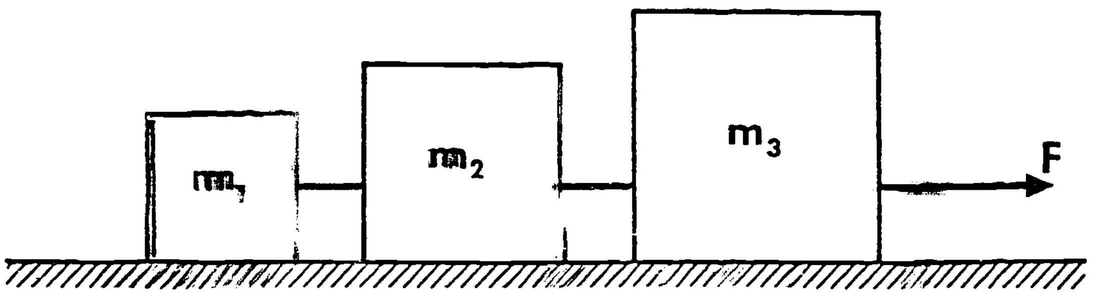
Schaum:	Ch 5, No 20

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 1: Newton's Laws of Motion

1. In the figure below, a force F of 90 nt accelerates three blocks of mass m_1 = 20 kg, m_2 = 30 kg, and m_3 = 40 kg. What is the tension in the cord connecting m_1 and m_2? (The plane is frictionless.)



A. 20 nt
B. 40 nt
C. 90 nt
D. 30 nt

Reading Assignment:

Halliday and Resnick: Ch 5, Sect 4, 5, 10

Related Problems:

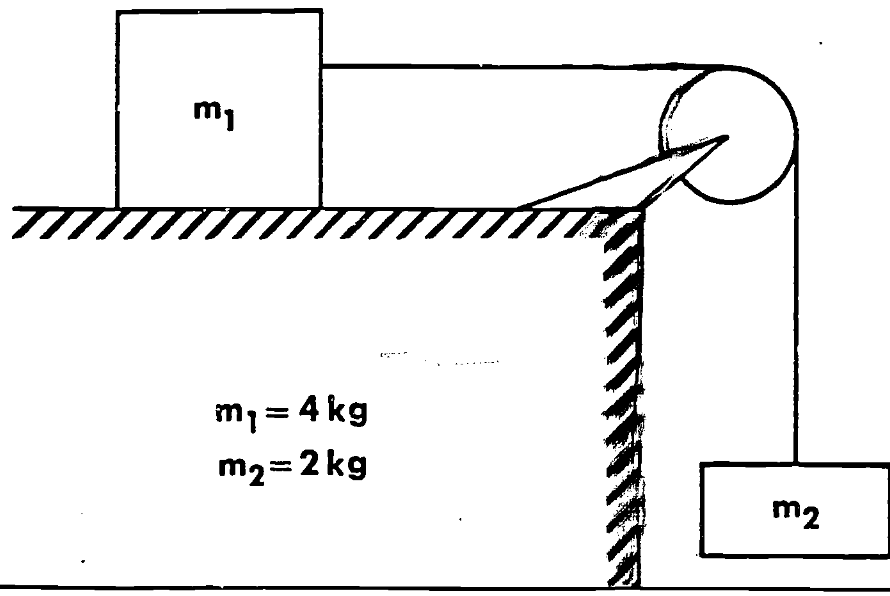
Schaum: Ch 5, No 14

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 2: Newton's Laws of Motion

2. Referring to the figure, what is the acceleration of m_1? Assume the idealized conditions of a frictionless table and massless pulley and cord. Be sure to draw a free-body diagram and to use a consistent sign convention.



Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 10 or 6
Semat and Blumenthal:	Vol I, Ch 4, Fr 20-22
Joseph and Leahy:	Part I, Ch 3, Sect 10, Fr 85-89

Related Problems:

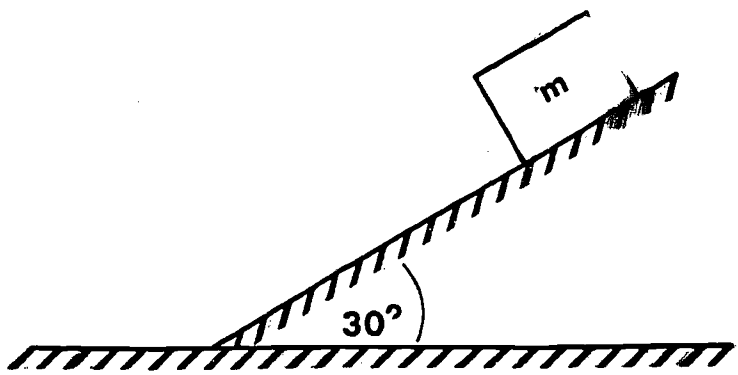
Schaum:	Ch 5, No 21

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 5: Coefficients of Friction

5. In the diagram, you can see a 30 lb block on an inclined plane with coefficient of kinetic friction $\mu_k = 0.40$ and coefficient of static friction $\mu_s = 0.60$. What will the block do when released from rest?



A. remain at rest
B. slide with constant velocity down the plane
C. accelerate down the plane

Reading Assignment:

Halliday and Resnick: Ch 6, Sect 1, 2

Related Problems:

Schaum: Ch 5, Nos 18, 20

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 10: Friction on an Inclined Plane

10. Refer to the diagram in problem 5. The block slides down the plane inclined at 30° with constant velocity. What is the coefficient of kinetic friction?

Reading Assignment:

Halliday and Resnick: Ch 6, Sect 1, 2

Related Problems:

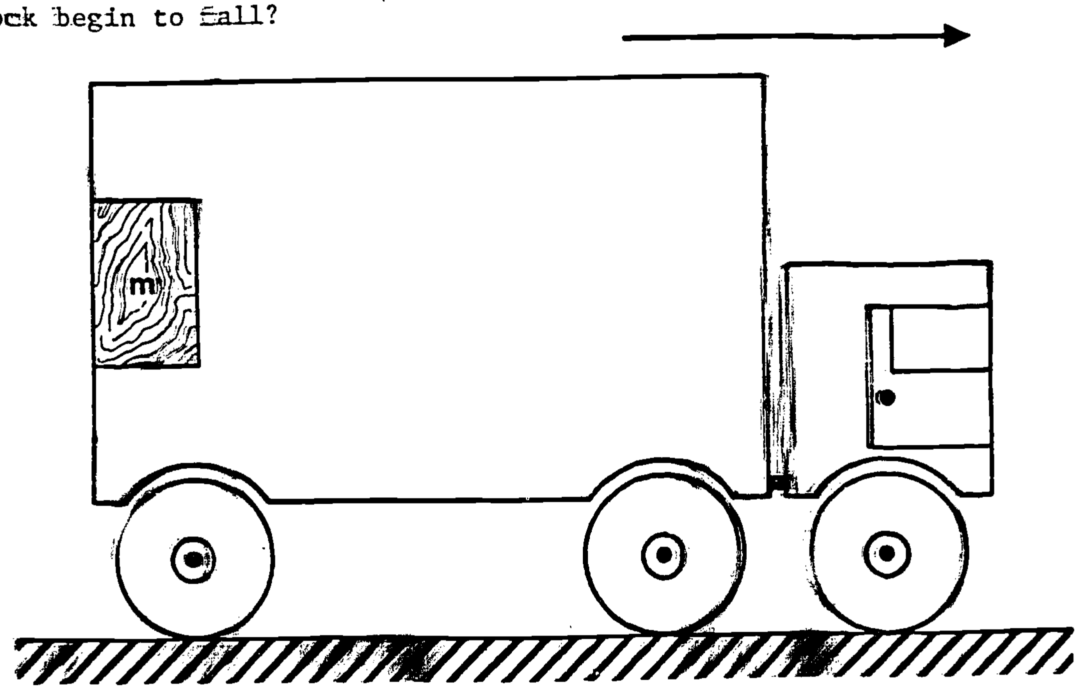
Schaum: Ch 5, Nos 18, 20

SEGMENT 5

LINEAR MOTION; FRICTION

Problem II: Friction on a Vertical Plane

11. The truck shown in the diagram accelerates at 30 m/sec^2 with a 20-kg block stuck to the back door as a result of the friction between it and the door. The coefficients of static and kinetic friction are 0.5 and 0.5 respectively for all surfaces inside the truck. If the truck begins to reduce its acceleration, at what acceleration will the block begin to fall?



Reading Assignment:

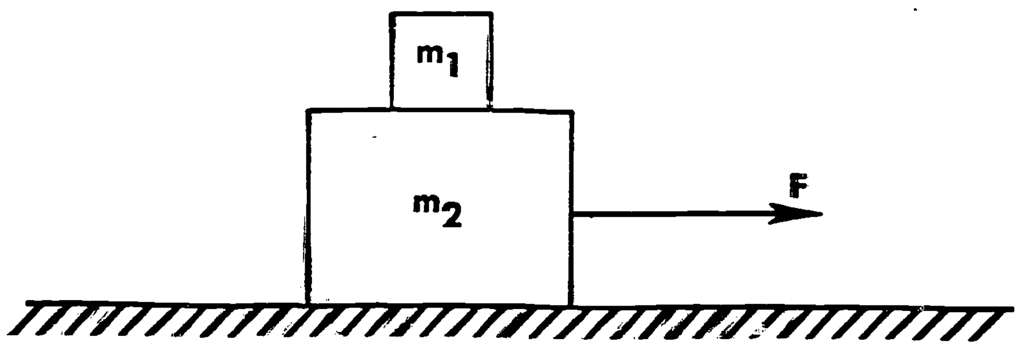
Halliday and Resnick:	Ch 6, Sect 1, 2
Semat and Blumenthal:	Vol I, Ch 4, Pr 26-29, 31-33
Joseph and Leahy:	Part I, Ch 3, Sect 7, Pr 17, 18, 26-30

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 12: Friction on a Horizontal Plane

12.



In the diagram, a force F of 136 nt pulls two blocks along a horizontal surface (m_1 = 10 kg, m_2 = 20 kg). The coefficients of static and kinetic friction for all surfaces are $\mu_s = 0.055$ and $\mu_k = 0.040$.

True or false? Block one will *move to the left* relative to block two.

Reading Assignment:

Halliday and Resnick: Ch 6, Sect 1, 2

Related Problems:

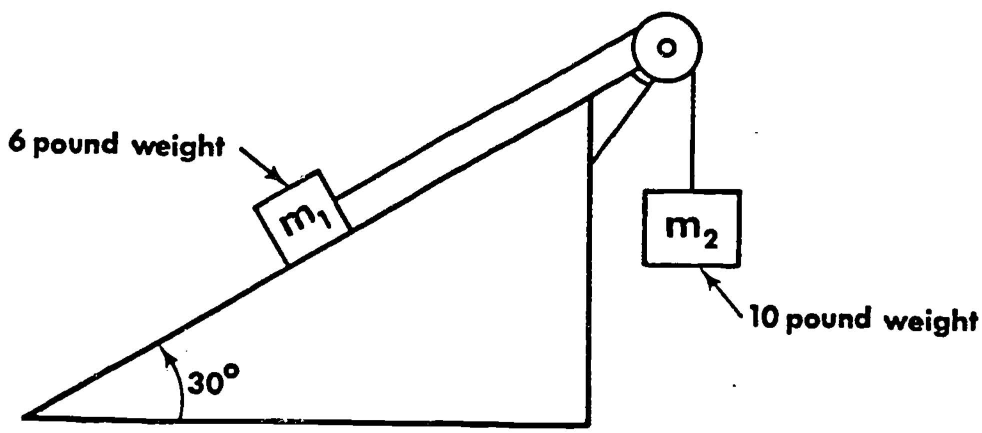
Schaum: Ch 5, Nos 15, 16

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 13: Friction on an Inclined Plane

13. As shown in the figure, a 6-pound weight on the inclined plane (coefficient of kinetic friction between the weight and the surface is $\mu_k = 0.2$) is connected by a light inextensible string to a 10-lb weight. The string passes over an ideal frictionless, massless pulley. What is the magnitude and direction of the acceleration of the 10-lb weight?



A. 8.7 ft/sec^2 upward
B. 15. ft/sec^2 upward
C. 16. ft/sec^2 downward
D. 7.4 ft/sec^2 downward

Reading Assignment:

Halliday and Resnick:	Ch 6, Sect 1, 2
Semat and Blumenthal:	Vol I, Ch 4, Fr 31-33
Joseph and Leahy:	Part I, Ch 3, Sect 7, Fr 26-30

Related Problems:

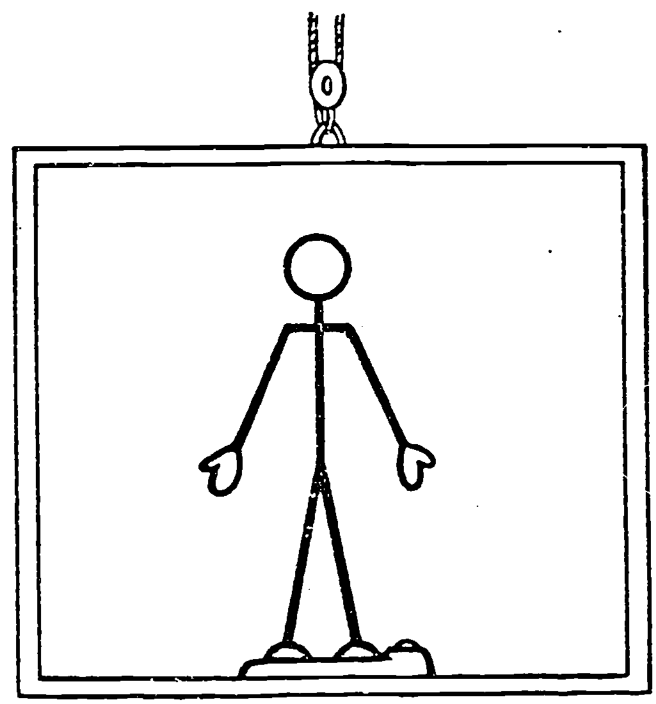
Schaum:	Ch 5, Nos 19, 21, 22

SEGMENT 5

LINEAR MOTION; FRICTION

Problem 18: Accelerated Vertical Motion

18. In the figure below, a man is standing in an elevator which is initially stationary. The weight scale under the man reads 160 lb. The elevator then accelerates upward at 5 ft/sec^2. What is the new reading on the scale?



Reading Assignment:

Halliday and Resnick:	Ch 5, Sect 10 ex 8
Semat and Blumenthal:	---------
Joseph and Leahy:	Part I, Ch 3, Sect 9, Fr 38, 39, 52

Related Problems:

Schaum:	Ch 5, No 11

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 1: Relation Between Linear and Angular Quantities

1. The rim of a rotating bicycle wheel has a tangential velocity of 30 m/sec. If 0.5 m is the radius of the rotating wheel, how many revolutions per minute (rev/min) would be recorded by a tachometer? (A tachometer is an instrument used to measure revolutions per minute).

Reading Assignment:

Halliday and Resnick: Ch 4, Sect 4; Ch 11, Sect 5

Related Problems:

Schaum: Ch 9, Nos 2, 3, 4

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 2: Characteristics of Uniform Circular Motion

2. A particle moves at constant speed in a circular path of radius r. The particle makes one complete revolution every second. Calculate the acceleration of the particle if r = 0.5 m.

A. 19.8 m/sec
B. 12.6 m/sec^2
C. 19.8 m/sec^2
D. 1.98 m/sec^2

Reading Assignment:

Halliday and Resnick:	Ch 4, Sect 4
Semat and Blumenthal:	Vol I, Ch 6, Fr 1-3
Joseph and Leahy:	Part I, Ch 5, Sect 3, Fr 1-36

Related Problems:

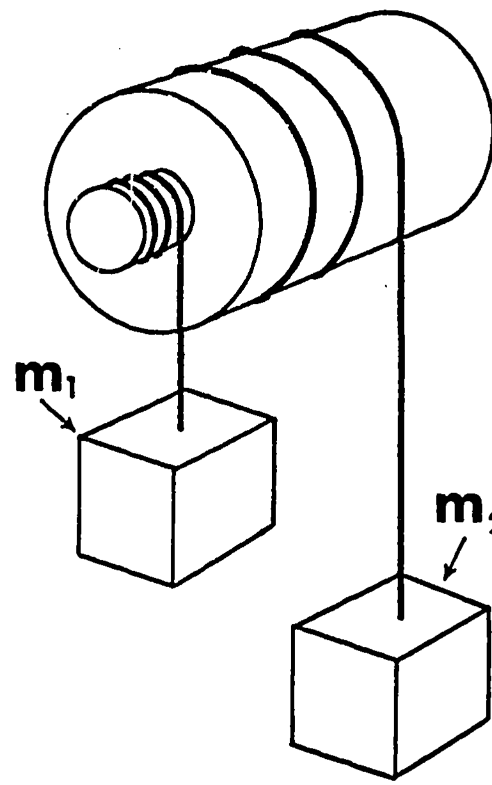
Schaum:	Ch 10, No. 1

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 8: Circular Motion

8. Two blocks are lowered by a winch made of two concentric cylinders. The smaller cylinder has a radius of 0.04 m, and the larger cylinder has a radius of 1 m. If the winch turns at 3 rev/min, what are the vertical velocities of block one and block two (v_1 and v_2)?



Reading Assignment:

Halliday and Resnick:	Ch 4, Sect 4, Ch 11, Sect 5
Semat and Blumenthal:	Vol I, Ch 7, Fr 1-16
Joseph and Leahy:	Part I, Ch 5, Sect 3, Fr 1-10

Related Problems:

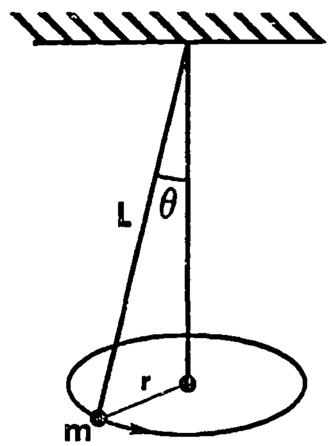
Schaum:	Ch 9, Nos 2, 3, 4

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 9: Centripetal Force in a Horizontal Plane

9. The figure shows a mass $m = 2$ kg revolving in a horizontal circle. The mass is suspended from a string 98 cm in length. The motion of the string traces out a cone. If the string makes an angle of 30° with the vertical, how long does it take for the mass to make one revolution?



Reading Assignment:

Halliday and Resnick: Ch 6, Sect 3

Related Problems:

Schaum: Ch 10, No 4

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 14: Centripetal Force

> 14. A copper penny is placed 4 inches from the center of a hi-fi record. The record plus penny are then placed on a phonograph turntable (33 1/3 rev/min) and the switch is turned on. The coefficient of static and kinetic friction are 0.1 and 0.05 respectively. At what angular velocity will the penny begin to slide?

Reading Assignment:

Halliday and Resnick:	Ch 6, Sect 3, Ch 11, Sect 5
Semat and Blumenthal:	Vol I, Ch 6, Fr 1-5
Joseph and Leahy:	Part I, Ch 5, Sect 4, Fr 1-10, 18-23

Related Problems:

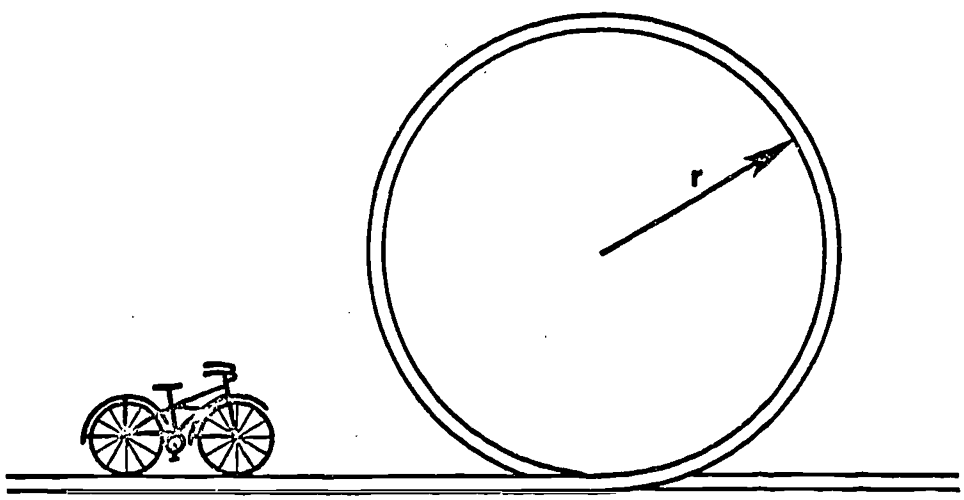
Schaum:	Ch 10, Nos 1, 2

SEGMENT 6

UNIFORM CIRCULAR MOTION

Problem 15: Centripetal Force in a Vertical Plane

15. A man plans to perform the loop-the-loop with his bicycle at the county fair (see the diagram below). The radius r is equal to 10 ft. What is the minimum speed at which he can safely perform the stunt?



A. depends on the man's mass
B. 12.2 mi/hr
C. 20 ft/sec
D. 9.6 mi/hr

Reading Assignment:

Halliday and Resnick: Ch 6, Sect 3

Related Problems:

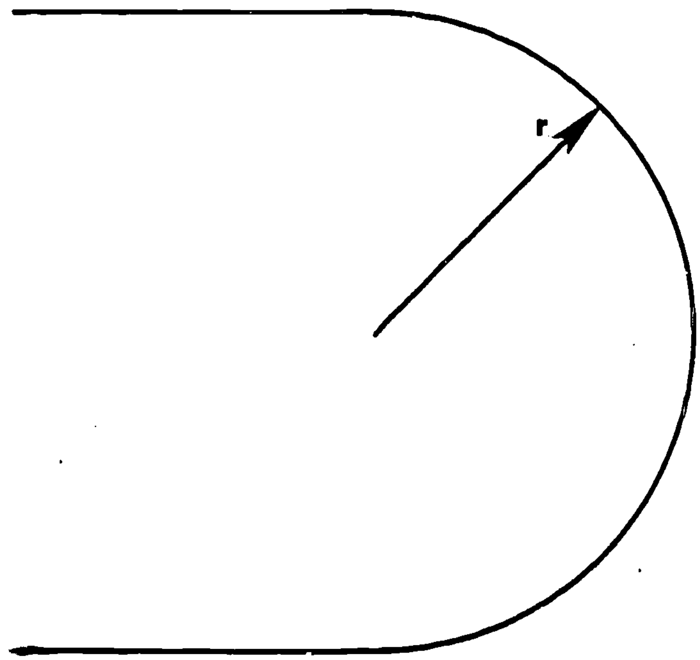
Schaum: Ch 10, No. 5

SEGMENT 6

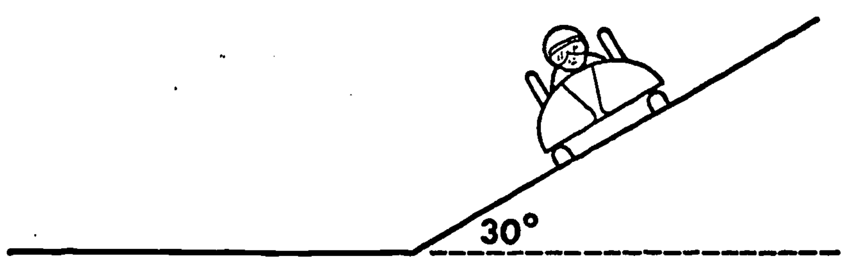
UNIFORM CIRCULAR MOTION

Problem 16: Centripetal Force

16. A bobsled speeds around the curve shown in the figure below. The curve has been well iced and can be considered frictionless. The sled moves in a circular arc of radius = 100 m and banking angle of 30°; what is its speed?



Curve view from the top



Bobsled on banked curve

Reading Assignment:

Halliday and Resnick:	Ch 6, Sect 3
Semat and Blumenthal:	Vol I, Ch 6, Fr 7-9
Joseph and Leahy:	Part I, Ch 5, Sect 4, Fr 1-10, 14-17

Related Problems:

Schaum:	Ch 10, No. 3

SEGMENT 7

WORK AND ENERGY

Problem 1: Definition of Work

1. A 2-kg particle is moving in a circle with an angular velocity of 10 rad/sec. The diameter of the circle is 1 m. How much work is done on the particle by the centripetal force during one revolution?

   A. 400π j
   B. 200π j
   C. 100π j
   D. Zero j

Reading Assignment:

Halliday and Resnick:	Ch 7, Sect 1, 2
Semat and Blumenthal:	Vol I, Ch 5, Fr 1-6
Joseph and Leahy:	Part I, Ch 7, Sect 1, Fr 1-13, 19, 24-41; Sect 3, Fr 1-13

Related Problems:

Schaum:	Ch 6, Nos. 4, 5

SEGMENT 7

WORK AND ENERGY

Problem 2: Work Done by a Constant Force

2. A safe having a mass of 2 slugs is moved up a 30° frictionless inclined plane for a distance of 15 ft. Calculate the work done on the safe.

Reading Assignment:

Halliday and Resnick:	Ch 7, Sect 1, 2
Semat and Blumenthal:	Vol I, Ch 5, Fr 1-6
Joseph and Leahy:	Part I, Ch 7, Sect 1, Fr 24-41

Related Problems:

Schaum:	Ch 6, No. 5

SEGMENT 7

WORK AND ENERGY

Problem 5: Work Done by a Varying Force

5. A mass $m = 2$ kg moves in the direction of an applied force varying with displacement according to the equation

$$F = m(\alpha + \beta x^2)$$

where $\alpha =$ [illegible] m/sec^2, $\beta = 15\ m^{-1}\ sec^{-2}$, and x is the displacement. Find the work done on the mass during the first 2 m of its journey.

A. 260 j
B. 130 j
C. 100 j
D. 20 j

Reading Assignment:

Halliday and Resnick:	Ch 7, Sect 3

SEGMENT 7

WORK AND ENERGY

Problem 10: Power Expended by an Escalator

10. An escalator, inclined at 37° from the horizontal, has a motor that can deliver a maximum power of 10 hp. If the escalator is moving with a constant speed of 2 ft/sec., what is the maximum number of passengers, with an average weight of 150 lb, that the escalator can handle?

A. 30
B. 18
C. 41
D. 31

Reading Assignment:

Halliday and Resnick: Ch 7, Sect 7

Related Problems:

Schaum: Ch 6, No 18

SEGMENT 7

WORK AND ENERGY

Problem: 15: Projectile Motion and Kinetic Energy

15. A 2-kg particle is projected from ground level with an initial velocity of 20 m/sec, at 60° above the horizontal. Find the kinetic energy of the particle when it reaches its highest altitude; i.e., where the vertical component of the velocity is zero. (Neglect air resistance.)

Reading Assignment:

Halliday and Resnick: Ch 4, Sect 3; Ch 7, Sect 5

Related Problems:

Schaum: Ch 4, Nos. 11, 16, 18; Ch 6, No. 8

SEGMENT 7

WORK AND ENERGY

Problem 18: The Work-Energy Theorem

18. A block is projected with an initial speed of 8 m/sec, down a frictionless plane inclined 45° from the horizontal. Find the speed of the block after it has traveled for a distance of 2.6 m along the incline. (Use the work-energy theorem in your solution.)

Reading Assignment:

Halliday and Resnick:	Ch 7, Sect 5, 6
Semat and Blumenthal:	Vol I, Ch 5, Fr 10-11
Joseph and Leahy:	Part I, Ch 8, Sect 1, Fr 1-27

Related Problems:

Schaum:	Ch 6, Nos. 13, 14

SEGMENT 7

WORK AND ENERGY

Problem 24: Composite Problem Involving Work, Energy, and Projectile Motion

24. A 30-gm bullet, fired with a speed of 300 m/sec, passes through a telephone pole 30 cm in diameter at a point 2 m above ground. The bullet's path through the pole is horizontal and along a diameter. While in the pole the bullet experiences an average force of 2500 nt. If air resistance is neglected, at what horizontal distance from the pole will the bullet hit the ground?

Reading Assignment:

Halliday and Resnick: Ch 4, Sect 3, Ch 7, Sect 5

Related Problems:

Schaum: Ch 4, Nos.16, 17; Ch 6, No. 11

SEGMENT 7

WORK AND ENERGY

Problem 27: Composite Problem Involving Work and Energy

27. A constant horizontal force $\vec{F}$, of magnitude 120 nt, is used to move a 10-kg block up a plane inclined at 37° from the horizontal. If the block starts from rest, and the coefficient of kinetic friction between the block and the plane is 0.200, what is the speed of the block after it has traveled 10 m along the plane?

A. 6.56 m/sec
B. 9.55 m/sec
C. 12.8 m/sec
D. 3.76 m/sec

Reading Assignment:

Halliday and Resnick:	Ch 7, Sect 2, 5
Semat and Blumenthal:	Vol I, Ch 5, Fr 1-6, 10, 11
Joseph and Leahy:	Part I, Ch 8, Sect 1, Fr 18-27, 37-43

Related Problems:

Schaum:	Ch 6, Nos. 13, 15

SEGMENT 8

CONSERVATION OF ENERGY

Problem 1: Work Done by Conservative Forces

1. The work-energy theorem states that the work done by the resultant force on a particle is equal to the change in kinetic energy of the particle, $W = \Delta K$. *If* the resultant force is conservative, we also know that the total energy of the particle does not change, $\Delta K + \Delta U = 0$. In this case, which of the following statements is correct?

The work done by the resultant conservative force is equal to

A. the change in the potential energy of the particle, $W = \Delta U$

B. the change in the total energy of the particle, $W = \Delta E$

C. the negative of the change in the total energy of the particle, $W = -\Delta E$

D. the negative of the change in the potential energy of the particle, $W = -\Delta U$

Reading Assignment:

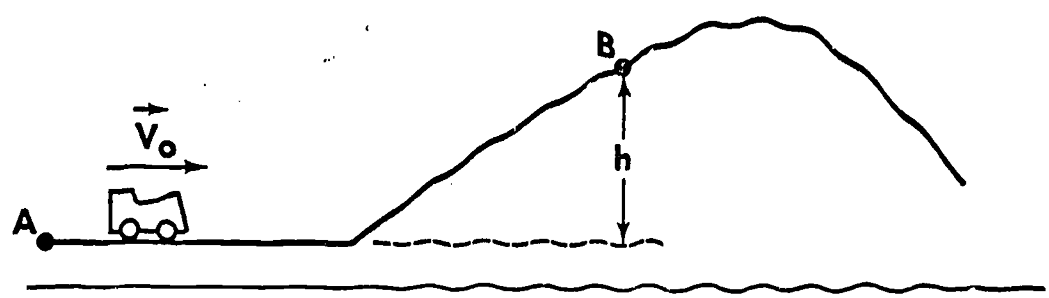
Halliday and Resnick: Ch 8, Sect 1, 2, 3

SEGMENT 8

CONSERVATION OF ENERGY

Problem 5: Conservation of Energy

5. A roller coaster moves at point A with speed v_o. At Point B, the coaster moves with speed (1/2) v_o. Assuming no frictional losses, what is the height of point B above point A?



A. $3\ v_o^2/8g$

B. $7\ v_o^2/8g$

C. $v_o^2/4g$

D. $5\ v_o^2/8g$

Reading Assignment:

Halliday and Resnick:	Ch 8, Sect 3, 4
Semat and Blumenthal:	Vol I, Ch 5, Pr 12-24
Joseph and Leahy:	Part I, Ch 8, Sect 3, Pr 1-29

Related Problems:

Schaum:	Ch 6, Nos. 9, 14

SEGMENT 8

CONSERVATION OF ENERGY

Problem 9: Potential Energy and the Related Force Function

9. For a force

$$F = -ky$$

where k is a constant, and for the choice $U = 0$ at $y = y_o$, what is the potential energy $U(y)$ of a particle located at an arbitrary point y?

Reading Assignment:

Halliday and Resnick: Ch 8, Sect 3, 4

SEGMENT 8

CONSERVATION OF ENERGY

Problem 13: Energy in Springs

13. A ball of mass m is dropped from rest onto a spring with spring constant k. The maximum compression of the spring is x. Find the height above the uncompressed spring from which the ball was dropped, assuming no friction at the time of impact.

A. $(kx^2/2mg) - x$

B. $(kx^2/2mg) + x$

C. $(kx^2/mg) - x$

D. kx^2/mg

Reading Assignment:

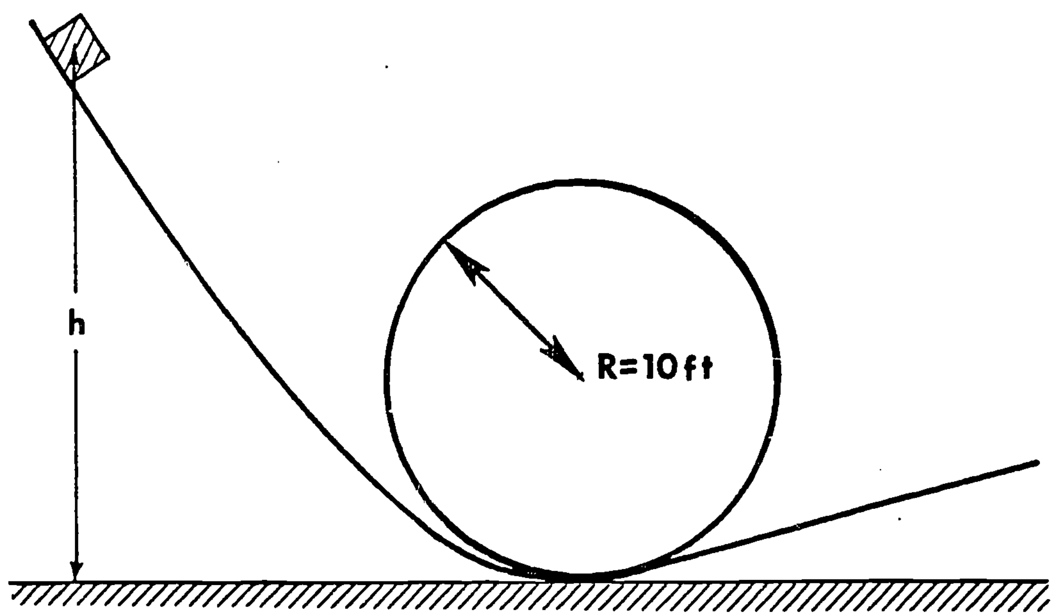
Halliday and Resnick:	Ch 8, Sect 4
Semat and Blumenthal:	Vol I, Ch 5, Fr 17-20, 25-29
Joseph and Leahy:	Part I, Ch 8, Sect 2, Fr 30-36; Sect 3, Fr 26-29

SEGMENT 8

CONSERVATION OF ENERGY

Problem 18: A Composite Problem Using Conservation of Energy

18.



Compute the minimum height h from which a 10-lb block can be released, in order that it will go around the loop without losing contact with the track. Assume a frictionless track.

Reading Assignment:

Halliday and Resnick:	Ch 6, Sect 3; Ch 8, Sect 4
Semat and Blumenthal:	Vol I, Ch 6, Fr 1-4, 10-13; Ch 5, Fr 12-18
Joseph and Leahy:	Part I, Ch 5, Sect 4, Fr 1-10; Ch 8, Sect 3, Fr 26-29

Related Problems:

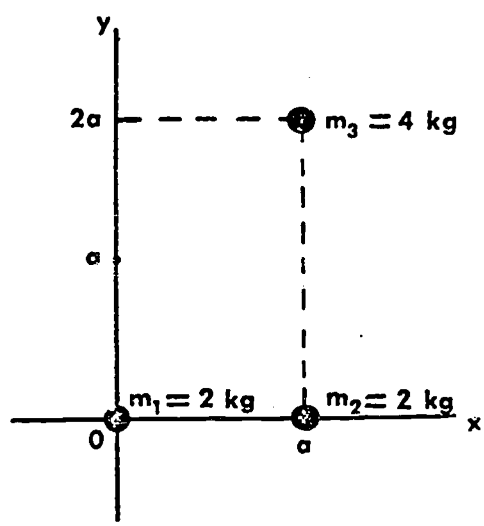
Schaum:	Ch 6, Nos. 7, 9; Ch 10, No. 5

SEGMENT 9

MOTION OF THE CENTER OF MASS

Problem 1: Calculation of Center of Mass

1. The coordinates of the center of mass of the system shown in the figure are



A. x = a; y = 1.33 a
B. x = 0.25 a; y = a
C. x = a; y = 0.75 a
D. x = 0.75 a; y = a

Reading Assignment:

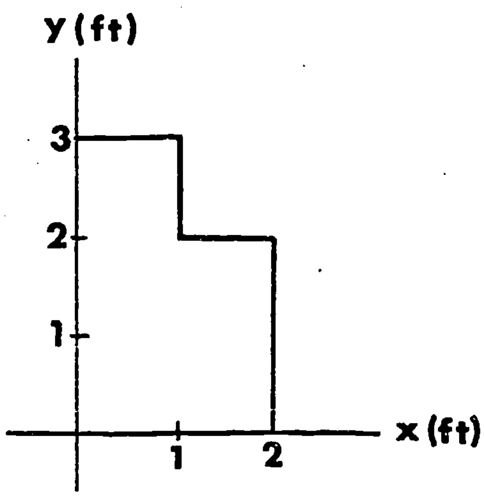
Halliday and Resnick:	Ch 9, Sect 1
Semat and Blumenthal:	------
Joseph and Leahy:	------

SEGMENT 9

MOTION OF THE CENTER OF MASS

Problem 4: Calculation of Center of Mass

4. A piece of 3/4 inch plywood has been cut into the shape shown. If uniform mass density and thickness are assumed for this piece of wood, then the center of mass is located at the point



A. (0.9, 1.0)
B. (1.3, 1.3)
C. (0.9, 1.3)
D. (1.0, 1.3)

Reading Assignment:

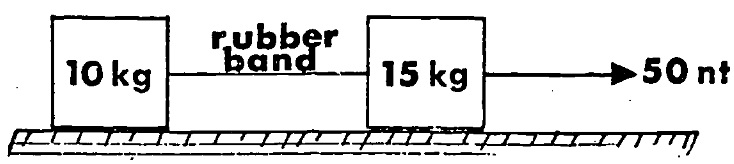
Halliday and Resnick: Ch 9, Sect 1

SEGMENT 9

MOTION OF THE CENTER OF MASS

Problem 6: Movement of Center of Mass

6. Two masses on a table are connected by a rubber band. A constant force of 50 nt is applied to the right mass as shown. The coefficient of kinetic friction between each mass and the table is $\mu = 0.2$. The left mass is 10 kg and the right mass is 15 kg. What is the acceleration of the center of mass when both masses are moving to the right?



Reading Assignment:

Halliday and Resnick: Ch 9, Sect 2

Semat and Blumenthal: ---------

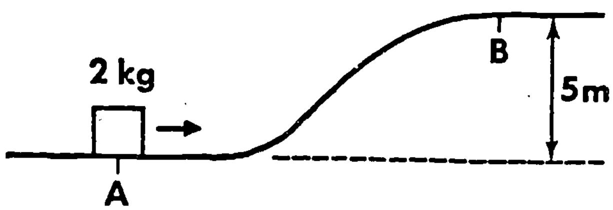
Joseph and Leahy: ---------

SEGMENT 10

LINEAR MOMENTUM

Problem 1: The Momentum of a Particle

1. A 2-kg block slides along the frictionless track shown in the figure.



If the block's speed at point A is 10 m/sec, what is the momentum in kg-m/sec of the block at point B?

Reading Assignment:

Halliday and Resnick:	Ch 8, Sect 4; Ch 9, Sect 3
Semat and Blumenthal:	Vol I, Ch 5, Fr 12-18, Ch 4, Fr 37
Joseph and Leahy:	Part I, Ch 8, Sect 3, Fr 26-29, Ch 6, Sect 2, Fr 9-15

Related Problems:

Schaum:	Ch 8, Nos 1,2,3

SEGMENT 10

LINEAR MOMENTUM

Problem 5: Momentum of a System of Particles

5. Two particles of mass 2 kg and 3 kg respectively, are moving with a speed of 10 m/sec due east. A third particle of mass 2 kg is moving with a speed of 25 m/sec due north. Determine the velocity of the center of mass, $\vec{v}_{cm}$, of the system of three particles.

A. 10.1 m/sec at 45° N of E
B. 20.2 m/sec at 37° N of E
C. 10.1 m/sec at 37° N of E
D. 20.2 m/sec at 45° N of E

Reading Assignment:

Halliday and Resnick:	Ch 9, Sect 4
Semat and Blumenthal:	------
Joseph and Leahy:	------

SEGMENT 10

LINEAR MOMENTUM

Problem 10: Newton's Second Law in Terms of Momentum

10. The total mass of a system is 3 kg and the magnitude of the system's momentum is changing at the rate of 15 kg-m/sec^2. What is the magnitude of the net external force exerted on the system?

Reading Assignment:

Halliday and Resnick:	Ch 9, Sect 3, 4
Semat and Blumenthal:	Vol 1, Ch 4, Fr 37-38
Joseph and Leahy:	Part I, Ch 6, Sect 3, Fr 45-56

SEGMENT 10

LINEAR MOMENTUM

Problem 13: Conservation of Momentum

13. An 8-ton, open-top freight car is coasting at a speed of 5 ft/sec along a frictionless horizontal track. It suddenly begins to rain hard, the raindrops falling vertically with respect to ground. Assuming the car to be deep enough, so that the water does not spatter over the top of the car, what is the speed of the car after it has collected 4.5 tons of water?

Reading Assignment:

Halliday and Resnick:	Ch 9, Sect 5, 6
Semat and Blumenthal:	Vol I, Ch 4, Fr 41-44
Joseph and Leahy:	Part I, Ch 6, Sect 8, Fr 28-35, 54-58

Related Problems:

Schaum:	Ch 8, Nos 3, 6

SEGMENT 11

IMPULSE AND COLLISIONS

Problem 1: Definition of Impulse

1. An impulsive force proportional to time is applied to a block. The constant of proportionality is k, and the total time during which the force is applied is T. Assume that at time $t = 0$, $F = 0$. What is the magnitude of the total impulse?

   A. $(\frac{1}{2})kT^2$
   B. FT
   C. kT^2
   D. $(\frac{1}{2})(T^2/k)$

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 2
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 38-40
Joseph and Leahy:	Part I, Ch. 6, Sect 1, Fr 1-31

Related Problems:

Schaum:	Ch. 8, No. 4

SEGMENT 11

IMPULSE AND COLLISIONS

Problem 5: Impulse and Momentum

5. A baseball is thrown by a pitcher at 90 mi/hr toward the strike zone. The batter hits a line drive, reversing the original direction of the ball's motion. If the ball weighs 4 oz., is in contact with the bat for 0.01 sec., and leaves the bat at 150 mi/hr, what is the magnitude of the average force on the ball during the time of contact?

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 2, 3
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 38-40
Joseph and Leahy:	Part I, Ch. 6, Sect. 3, Fr 1-55

Related Problems:

Schaum:	Ch. 8, No. 4

SEGMENT 11

IMPULSE AND COLLISIONS

Problem 11: Conservation of Linear Momentum

11. A machine gunner on the bow of a boat fires his gun horizontally. The gun is firing 600 rounds per minute. Each shell weighs 2 ounces and has a muzzle speed of 3200 ft/sec. The combined weight of the boat, gunner, machine gun, etc., is one ton. Neglecting friction and assuming the boat to be initially at rest, what is its speed after five seconds of continuous firing?

A. 80 ft/sec
B. 10 ft/sec
C. 5 ft/sec
D. 2 ft/sec

Reading Assignment:

Halliday and Resnick:	Ch. 9, Sect. 5, 6
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 41-45
Joseph and Leahy:	Part I, Ch. 6, Sect. 4, Fr 6-38

Related Problems:

Schaum:	Ch. 8, No. 5

SEGMENT 11

IMPULSE AND COLLISIONS

Problem 15: Inelastic Collision in One-Dimension

15. A railroad car of mass 1000 kg is rolling down a track at 3 m/sec. It strikes a stationary car of mass 2000 kg. If the two cars couple together, what is the speed of the combination after the collision? (neglect friction)

A. 1 m/sec
B. 0 m/sec
C. 3 m/sec
D. 2 m/sec

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 3, 4
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 41-43
Joseph and Leahy:	Part I, Ch. 6, Sect. 7, Fr 14-33

Related Problems:

Schaum:	Ch. 8, Nos. 1, 2

SEGMENT 11

IMPULSE AND COLLISIONS

Problem 18: Elastic Collision in One-Dimension

18. A steel ball of 2-kg mass (m_1), moving to the right along a horizontal frictionless surface at a speed of 40 m/sec., collides head-on with another 2-kg steel ball (m_2) moving to the left at 20 m/sec. After the collision, m_1 recoils and moves to the left at 20 m/sec. Assuming the collision to be perfectly elastic, in which direction and with what speed will m_2 move after the collision?

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 3, 4
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 41-43
Joseph and Leahy:	Part I, Ch. 6, Sect. 8, Fr 43-46

Related Problems:

Schaum	Ch. 8, No. 8

SEGMENT 12

COLLISIONS IN TWO DIMENSIONS

Problem 1: Elastic Collision in One Dimension

1. In a one-dimensional elastic collision between two objects, mass m_2 is initially at rest. If $u_1 = 1$ km/sec. and $m_1 = 2m_2$, what is the final velocity of m_1?

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 3, 4
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 41-42
Joseph and Leahy:	Part I, Ch. 8, Sect. 9, Fr 9-11

Related Problems:

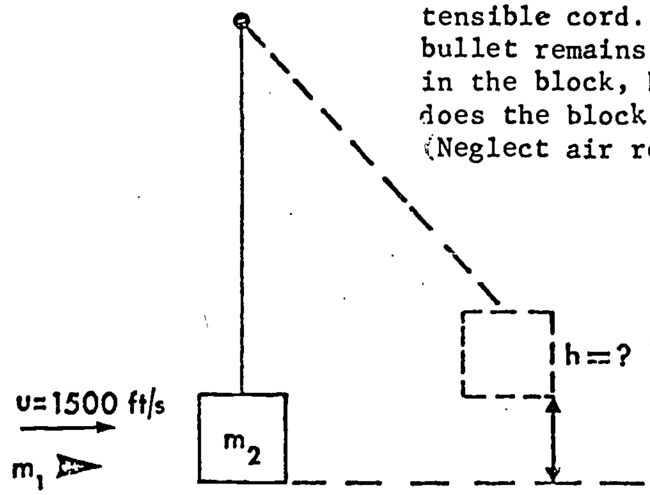
Schaum:	Ch. 8, No. 8

SEGMENT 12

COLLISIONS IN TWO DIMENSIONS

Problem 6: The Ballistic Pendulum

6. A 1/2-ounce bullet traveling horizontally with a muzzle speed of 1500 ft/sec strikes a 5-pound block suspended from a fixed point with 5-foot, massless, inextensible cord. If the bullet remains embedded in the block, how high does the block rise? (Neglect air resistance.)



A. 5.00 ft
B. 2.18 ft
C. 1.36 ft
D. 1.00 ft

Reading Assignment:

Halliday and Resnick:	Ch. 10, Sect. 4
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 41-43
Joseph and Leahy:	Part I, Ch. 8, Sect. 8, Fr 1-25

Related Problems:

Schaum:	Ch. 8, Nos. 1, 3

SEGMENT 12

COLLISIONS IN TWO DIMENSIONS

Problem 10: Elastic Collision in Two Dimensions

10. A mass m_1 collides perfectly elastically with a stationary mass m_2. After the collision the two masses move at right angles to one another. What is the ratio m_2/m_1? (HINT: Choose $\vec{v}_1$ along the x-axis and $\vec{v}_2$ along the y-axis.)

Reading Assignment:

Halliday and Resnick: Ch. 10, Sect. 4, 6

Related Problems:

Schaum: Ch. 8, No. 8

SEGMENT 12

COLLISIONS IN TWO DIMENSIONS

Problem 14: Inelastic Collision in Two Dimensions

14. A 1000-kg auto moving north at 60 km/hr collides perfectly inelastically with a 2000-kg truck moving east at 40 km/hr. How much mechanical energy is dissipated during the collision?

Reading Assignment:

Halliday and Resnick: Ch. 10, Sect. 4, 6

Related Problems:

Schaum: Ch. 8, Nos. 2, 6

SEGMENT 13

GRAVITATION

Problem 1: Gravitational Force Between Point Masses

1. In the Bohr picture of the hydrogen atom, the electron revolves about the proton in a circular orbit of radius 5.3×10^{-11} m and period 1.5×10^{-16} sec. The mass of the electron is $m_e = 9.1 \times 10^{-32}$ kg, and that of the proton is $m_p = 1.7 \times 10^{-27}$ kg. Calculate the gravitational force of the proton on the electron.

Reading Assignment:

Halliday and Resnick:	Ch. 16, Sect. 2, 3
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 46-47

SEGMENT 13

GRAVITATION

Problem 4: Acceleration Due to Gravity

4. If a Martian were working on the law of universal gravitation by considering that Mars acted as a particle attracting a Martian apple and a Martian moon according to the same law, he could calculate the distance of that moon from Mars on the assumption that the gravitational attraction falls off as the inverse square of the distance from the center of Mars. From measurements made on Mars he obtains $g = 3.8$ m/sec^2 for the acceleration of a falling apple, $R = 3.4 \times 10^6$ m for the radius of Mars and $T = 2.76 \times 10^4$ sec for the period of Phobos (the larger of Mars' two moons). What value would he obtain for the radius of Phobos' orbit about Mars? (assumed circular)

A. 1,580 km
B. 9,500 km
C. 16,000 km
D. 17,500 km

Reading Assignment:

Halliday and Resnick:	Ch. 16, Sect. 2, 3
Semat and Blumenthal:	Vol. I, Ch. 4, Fr 46-49

Related Problems:

Schaum:	Ch. 5, No. 25

SEGMENT 13

GRAVITATION

Problem 10: Inertial and Gravitational Mass

10. Inertial and gravitational masses are conceptually distinct, although experimentally the same. We use one symbol, m, to denote both kinds of masses. In which of the following equations does m stand for gravitational mass?

1. $\vec{F} = m\vec{a}$
2. $\vec{p} = m\vec{v}$
3. $K = \frac{1}{2} mv^2$
4. $F = \frac{mv^2}{r}$
5. $F = \frac{GMm}{r^2}$
6. $g = \frac{Gm}{R_e^2}$
7. $U = mgh$
8. $T = 2\pi\sqrt{m/k}$

A. All of them
B. Numbers 3, 5, and 7
C. Numbers 5, 6, and 7
D. None of them

Reading Assignment:

Halliday and Resnick: Ch. 16, Sect. 4, 13

Joseph and Leahy: Part I, Ch. 4, Sect. 1, Fr 1-23

SEGMENT 13

GRAVITATION

Problem 11: Weight on a Rotating Planet

11. For a perfectly spherical Earth of radius 6.37×10^6 with its axis through both poles, how much more (or less) would a 70-kg man weigh at either pole than he would on the equator? (Assume the weighing to be done with a "massless" spring balance.)

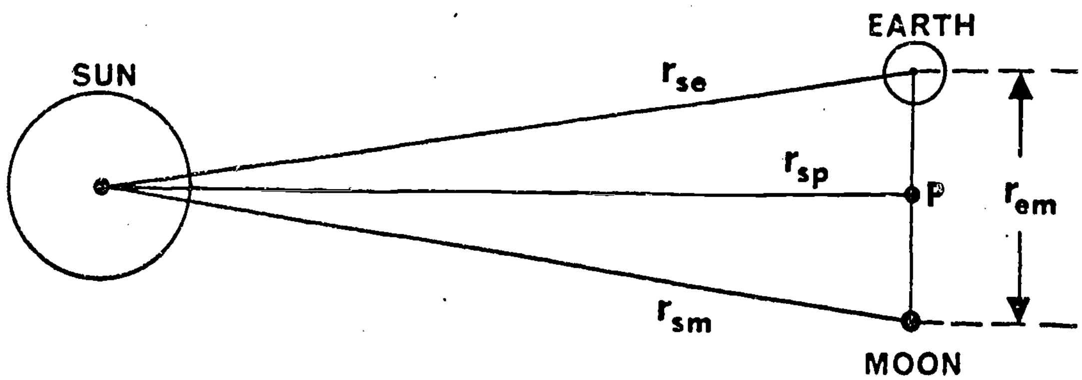
A. he would weigh the same
B. 3.62 nt more
C. 2.36 nt more
D. 2.36 nt less

Reading Assignment:

Halliday and Resnick: Ch. 16, Sect. 5

Problem 15: Gravitational Field Strength

15.



Referring to the diagram, point P is midway along the line from the Earth to the moon. This line is normal to the radius vector from the sun to P, so the Earth and the moon are equidistant from the sun. Neglecting the effects of other members of the solar system, compute the gravitational field strength at P.

A. 1.25×10^{-2} nt/kg; at an angle of 28° to the left of the line going from P to the sun

B. 1.25×10^{-2} nt/kg; at an angle of 62° above the line going from P to the moon

C. 5.9×10^{-3} nt/kg; directly toward the sun

D. 5.9×10^{-3} nt/kg; directly away from the sun

Reading Assignment:

Halliday and Resnick:	Ch. 16, Sect. 8
Joseph and Leahy:	Part I, Ch. 4, Sect. 3, Fr 1-58

SEGMENT 13

GRAVITATION

Problem 19: Gravitational Effects of Spherically Symmetric Mass Distribution

19. Consider a sphere of radius R and total mass M, having uniform mass density. Calculate the gravitational field associated with this sphere as a function of r, the distance of the field point from the center of the sphere.

A. $\gamma = -\frac{GM}{r^2}$ everywhere

B. $\gamma = 0$ for $r < R$; $\gamma = -\frac{GM}{r^2}$ for $r > R$

C. $\gamma = -\frac{GM}{R^3} r$ for $r < R$; $\gamma = -\frac{GM}{r^2}$ for $r > R$

D. $\gamma = -\frac{GM}{R^2}$ for $r < R$; $\gamma = -\frac{GM}{r^2}$ for $r > R$

Reading Assignment:

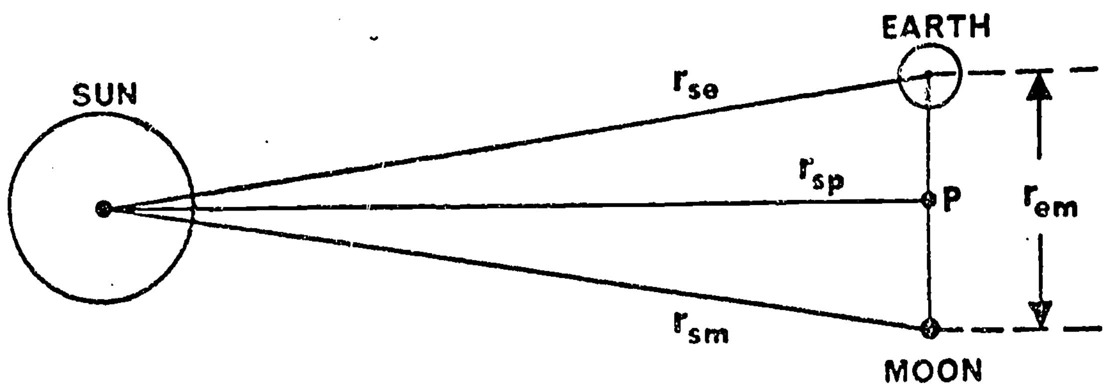
Halliday and Resnick: Ch. 16, Sect. 6

SEGMENT 14

GRAVITATIONAL POTENTIAL ENERGY

Problem 1: Gravitational Potential Energy

1.



Referring to the diagram, what is the work required to bring a spaceship of mass m to the position P (halfway between the Earth and moon) from infinity? Assume that the Earth, moon, and sun are stationary.

A. $-Gm\left(\frac{M_s}{r_{sp}} + \frac{M_e}{r_{em}} + \frac{M_m}{r_{em}}\right)$

B. $-Gm\left(\frac{M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{2M_m}{r_{em}}\right)$

C. $-Gm\left(\frac{2M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{2M_m}{r_{em}}\right)$

D. $-Gm\left(\frac{2M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{M_m}{r_{em}}\right)$

Reading Assignment:

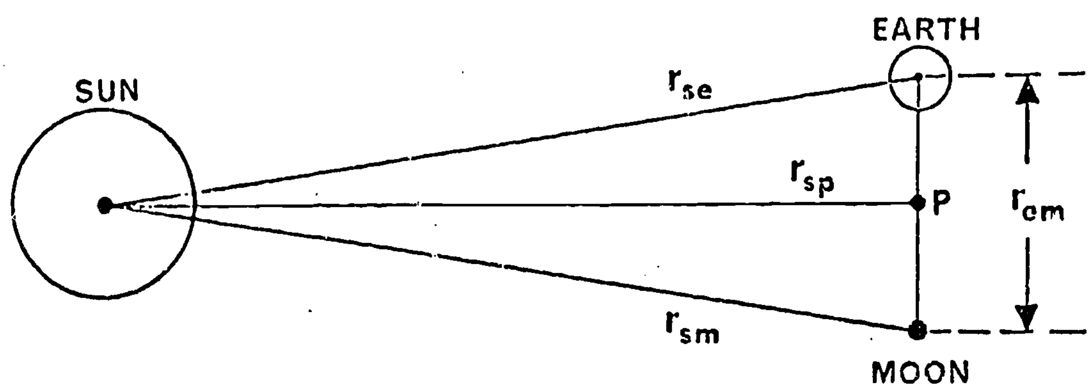
Halliday and Resnick: Ch. 16, Sect. 9, 10

SEGMENT 14

GRAVITATIONAL POTENTIAL ENERGY

Problem 6: Gravitational Potenial

6. What is the gravitational potential at the point P (halfway between the Earth and moon) in the diagram?



A. $-G\left[\frac{M_s}{r_{sp}} + \frac{M_e}{r_{em}} + \frac{M_m}{r_{em}}\right]$

C. $-G\left[\frac{2M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{2M_m}{r_{em}}\right]$

B. $-G\left[\frac{M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{2M_m}{r_{em}}\right]$

D. $-G\left[\frac{2M_s}{r_{sp}} + \frac{2M_e}{r_{em}} + \frac{M_m}{r_{em}}\right]$

Reading Assignment:

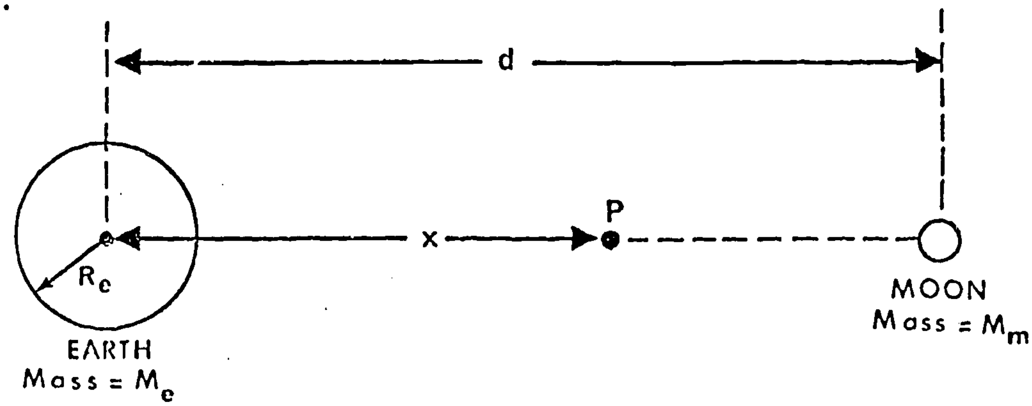
Halliday and Resnick: Ch. 16, Sect. 9

SEGMENT 14

GRAVITATIONAL POTENTIAL ENERGY

Problem 10: Conservation of Energy in the Gravitational Field

10. In the figure below, the gravitational field at point P is zero; hence, a spaceship placed there would experience no force and would remain there indefinitely if the Earth-moon system were a rigid body. (A rigid body is a body whose parts have a fixed location with respect to each other.) Suppose that the Earth-moon system were a rigid body and that the effects of all other celestial bodies were negligible; with what speed would a rocket, aimed directly toward the moon, have to leave the surface of the Earth in order that it would be "captured" at point P? Express your answer in terms of the symbols in the diagram below.



Reading Assignment:

Halliday and Resnick: Ch. 8, Sect. 3,8; Ch. 16, Sect. 9, 10

SEGMENT 14

GRAVITATIONAL POTENTIAL ENERGY

Problem 14: Escape Velocity

14. At what altitude above the Earth's surface is the escape velocity (speed) from the Earth equal to 10 km/sec? (Take the Earth's radius equal to 6400 km and its mass equal to 6×10^{24} kg.)

Reading Assignment:

Halliday and Resnick: Ch. 16, Sect. 9